

WHAT IS CLAIMED IS:

1. An estimation apparatus of an air intake flow for an internal combustion engine comprising:

5 a pressure sensor that detects an intake pressure in a portion just upstream of an intake valve of an intake system of the internal combustion engine; and

10 an air flow meter that detects an air intake flow rate fed from an upstream side of the intake system to the portion just upstream of the intake valve, wherein:

15 a first air intake flow rate fed into the portion just upstream of the intake valve at a predetermined timing prior to a timing for starting fuel injection is obtained based on an output of the air flow meter;

20 a variance in an air intake flow rate caused by a change in the intake pressure in the portion just upstream of the intake valve is obtained based on an output of the pressure sensor;

25 a second air intake flow rate fed into a cylinder of the internal combustion engine at the predetermined timing is obtained by adding the first air intake flow rate to the variance in the air intake flow rate; and

30 the second air intake flow rate fed into the cylinder is corrected to a third air intake flow rate required for estimating an actual air intake flow based on an amount of change in the second air intake flow rate fed into the cylinder at the predetermined timing.

2. The estimation apparatus of an air intake flow for an internal combustion engine according to claim 1, wherein the third air intake flow rate comprises an air intake flow rate in the cylinder at an intake valve closing timing.

3. An estimation apparatus of an air intake flow for an internal combustion engine comprising:

30 a pressure sensor that detects an intake pressure in a portion just upstream of an intake valve of an intake system of the internal combustion engine; and

35 an air flow meter that detects an air intake flow rate fed from an upstream side of the intake system to the portion just upstream of the intake valve, wherein:

a first air intake flow rate fed into the portion just upstream of the intake valve at a predetermined timing prior to a timing for starting fuel injection is obtained based on an output of the air flow meter;

5 a variance in an air intake flow rate caused by a change in the intake pressure in the portion just upstream of the intake valve is obtained based on an output of the pressure sensor;

a second air intake flow rate fed into a cylinder of the internal combustion engine at the predetermined timing is obtained by adding the first air intake flow rate to the variance in the air intake flow rate; and

10 the second air intake flow rate fed into the cylinder is corrected to a third air intake flow rate required for estimating an actual air intake flow based on an amount of change in a state of a mechanism of the internal combustion engine at the predetermined timing, the mechanism giving an influence on the air intake flow.

4. The estimation apparatus of an air intake flow for an internal combustion engine according to claim 3, wherein the third air intake flow rate comprises an air intake flow rate in the cylinder at an intake valve closing timing.

5. The estimation apparatus of an air intake flow for an internal combustion engine according to claim 3, wherein the mechanism of the internal combustion engine comprises at least one of an accelerator pedal, a throttle valve, and 20 a variable valve system that operates the intake valve of the internal combustion engine for controlling the air intake flow.

6. The estimation apparatus of an air intake flow for an internal combustion engine according to claim 3, wherein a state of the mechanism that gives an influence on an actual air intake 25 flow is estimated based on an amount of change in a state of the mechanism at the predetermined timing;

a difference between an air intake flow rate estimated based on the estimated state of the mechanism and an intake air flow rate fed into the cylinder at the predetermined timing, that is estimated based on the estimated state of the mechanism at the predetermined timing is calculated; and

30 the calculated difference is added to the second air intake flow rate so as to be corrected to a third air intake flow rate required for estimating the actual air intake flow such that an air intake flow fed into the cylinder is estimated.

7. The estimation apparatus of an air intake flow for an internal combustion engine according to claim 6, wherein the mechanism of the internal combustion engine comprises at least one of an accelerator pedal, a throttle valve, and a variable valve system that operates the intake valve of the internal combustion engine for controlling the air intake flow.

8. The estimation apparatus of an air intake flow for an internal combustion engine according to claim 6, wherein the air intake flow rate is estimated based on an opening degree of a throttle valve in consideration with an engine speed.

9. The estimation apparatus of an air intake flow for an internal combustion engine according to claim 6, wherein the air intake flow rate is estimated based on a maximum lift amount of the intake valve controlled by the variable valve system in consideration with an engine speed.

10. An estimation method of an air intake flow for an internal combustion engine including a pressure sensor that detects an intake pressure in a portion just upstream of an intake valve of an intake system of the internal combustion engine, and an air flow meter that detects an air intake flow rate fed from an upstream side of the intake system to the portion just upstream of the intake valve, the estimation method comprising:

15 obtaining a first air intake flow rate fed into the portion just upstream of the intake valve at a predetermined timing prior to a timing for starting fuel injection based on an output of the air flow meter;

20 obtaining a variance in an air intake flow rate caused by a change in the intake pressure in the portion just upstream of the intake valve based on an output of the pressure sensor;

25 obtaining a second air intake flow rate fed into a cylinder of the internal combustion engine at the predetermined timing by adding the first air intake flow rate to the variance in the air intake flow rate; and

30 correcting the second air intake flow rate fed into the cylinder to a third air intake flow rate required for estimating an actual air intake flow based on an amount of change in the second air intake flow rate fed into the cylinder at the predetermined timing.

11. An estimation method of an air intake flow for an internal combustion engine including a pressure sensor that detects an intake pressure in a portion just upstream of an intake valve of an intake system of the internal combustion engine,

and an air flow meter that detects an air intake flow rate fed from an upstream side of the intake system to the portion just upstream of the intake valve, the estimation method comprising:

5 obtaining a first air intake flow rate fed into the portion just upstream of the intake valve at a predetermined timing prior to a timing for starting fuel injection based on an output of the air flow meter;

obtaining a variance in an air intake flow rate caused by a change in the intake pressure in the portion just upstream of the intake valve based on an output of the pressure sensor;

10 obtaining a second air intake flow rate fed into a cylinder of the internal combustion engine at the predetermined timing by adding the first air intake flow rate to the variance in the air intake flow rate; and

15 correcting the second air intake flow rate fed into the cylinder to a third air intake flow rate required for estimating an actual air intake flow based on an amount of change in a state of a mechanism of the internal combustion engine at the predetermined timing, the mechanism giving an influence on the air intake flow.

12. The estimation method of an air intake flow for an internal combustion engine according to claim 11, wherein the mechanism of the internal combustion engine comprises at least one of an accelerator pedal, a throttle valve, and a variable valve system that operates the intake valve of the internal combustion engine for controlling the air intake flow.

13. The estimation method of an air intake flow for an internal combustion engine according to claim 11, wherein

25 a state of the mechanism that gives an influence on an actual air intake flow is estimated based on an amount of change in a state of the mechanism at the predetermined timing;

30 a difference between an air intake flow rate estimated based on the estimated state of the mechanism and an intake air flow rate fed into the cylinder at the predetermined timing, that is estimated based on the estimated state of the mechanism at the predetermined timing is calculated; and

 the calculated difference is added to the second air intake flow rate so as to be corrected to a third air intake flow rate required for estimating the actual air intake flow such that an air intake flow fed into the cylinder is estimated.

14. The estimation method of an air intake flow for an internal combustion engine according to claim 13, wherein the mechanism of the internal combustion engine comprises at least one of an accelerator pedal, a throttle valve, and a variable valve system that operates the intake valve of the internal combustion engine for 5 controlling the air intake flow.

15. The estimation method of an air intake flow for an internal combustion engine according to claim 13, wherein the air intake flow rate is estimated based on an opening degree of a throttle valve in consideration with an engine speed.

16. The estimation method of an air intake flow for an internal combustion engine according to claim 13, wherein the air intake flow rate is estimated based on a 10 maximum lift amount of the intake valve controlled by a variable valve system in consideration with an engine speed.